

No. 8. — *Notice of some Crinoids in the collection of the Museum of Comparative Zoölogy.* By AUSTIN HOBART CLARK.

Two species of Crinoids were met with during the cruise of the "Albatross" in the eastern Pacific, one near the Central American coast, and the other approximately midway between the Marquesas Islands and Central America. The former, an unstalked form belonging to *Heliometra*, is represented by four specimens from three stations; the latter, a species of *Bathycrinus*, is represented by a single specimen without arms. The *Bathycrinus*, however, is a species of considerable interest, for not only does it greatly extend the range of the genus, which was hitherto known in the Pacific only from Kamchatka and southern Japan, but it presents a most extraordinary superficial resemblance to *Rhizocrinus* in certain of the characters of the stem and basals; so close, in fact, that the specimen was first recorded (Mem. Mus. Comp. Zoöl, 1906, 33, p. 49) under that generic name, and a close examination under a microscope is necessary to reveal its true affinities.

Of the new species here described, *Heliometra juvenalis* calls for special mention. While undoubtedly closely allied to *H. eschrichtii*, it is remarkable in having prominent basals, cirri with less than twenty segments, and very short and stout lower pinnules, which are, in fact, much the shortest on the arms. The enlarged ovaries, however, containing ova, show that the specimens are adult, although the structure is that of very young specimens of other species of the genus. While no positive statement can be made on only two specimens, this seems to be a case of arrested development at a very early stage. Whether it is a permanent character or not must be left for future investigation; nothing similar is recorded, nor have I met with a similar case in my studies on the group.

STALKED CRINOIDS.

Bathycrinus equatorialis, sp. nov.

Radials and arms lacking.

Basals closely united into a smooth ring, slightly wider above than below, about as high as its greatest diameter; the sides of the ring are markedly convex, a character not known in any other species of *Bathycrinus*.

Stem 237 mm. long with ninety-two columnars; the five columnars immediately following the basal ring are very thin and discoidal, the sixth thicker, the seventh about twice the height of the sixth; the following segments increase in length, the sixty-fourth being 4.25 mm. long and 1 mm. in diameter, and the ninety-second 4.90 mm. long by 1.75 mm. in greatest diameter. The columnars differ from those of all known species of *Bathycrinus* in being practically cylindrical until after the eightieth, when the articulations begin to be very slightly enlarged; but they are never markedly "dice-box shaped," as in the other species. In general the stem bears a striking similarity to the stems of *Rhizocrinus*, the more so as the thin discoidal segments at the summit are closely united so as to appear, on superficial examination, as a single piece, and I had some difficulty at first in deciding to which genus it belonged. The basal ring is large for *Bathycrinus*, but shows no sutures whatever, even under strong magnification, nor is there the slightest evidence of incorporated radials. The small number of discoidal segments at the summit of the stem also suggests *Rhizocrinus*, but in that genus there are never more than two which are broader than long, and usually only one; the topmost columnar in *Rhizocrinus*, moreover, is always considerably longer than are the very thin proximal columnars of *Bathycrinus*. Examination of the surface ornamentation of the basals and columnars shows the deep and confluent pitting peculiar to *Bathycrinus*, and not the fine, shallow, scattered indentations of *Rhizocrinus*.

As an item of interest it may be mentioned that the seventeenth, fifty-fourth, and fifty-fifth columnars have the axes of both faces in the same plane; the axes are normally at right angles to each other, although occasionally the angle of divergence is considerably less than 90° .

The rapid enlargement of the proximal columnars, together with their segregation into what appears superficially to be a single segment, and the cylindrical form of the majority suggest an interesting possibility in regard to the original figure of *Bathycrinus aldrichianus*. Of this figure Dr. Carpenter says: "The numerous thin joints immediately beneath the cup, which are so characteristic of the genus, are not properly represented in the woodcut, and the joints just below where these ought to be are considerably longer than one would expect to find so near the cup. It may be assumed that Mr. Wild's drawing was photographic in its accuracy, so far as he could make out the structure of the small specimen; but errors may have crept in during its reproduction on wood, and the cut was published during Sir Wyville's absence from England, so that he had no opportunity of revising it. Under these circumstances it appeared preferable to say nothing about the stem in the specific diagnosis given above rather than to attempt to describe it from a probably incorrect woodcut." While in *Bathycrinus australis*, *B. carpenterii*, and *B. pacificus* from twenty to twenty-five or even more of the proximal columnars are short and discoidal, in *B. gracilis* and *B. complanatus* the number is much reduced, being only about half as many or even less; in *B. equatorialis* only the first five are short enough to be comparable to the proximal segments in the other species, and from then on the length increases rapidly.

In *B. aldrichianus* the stem is represented as having only a single segment wider than high. Judging from *B. equatorialis*, this segment might easily have been three or four coalesced columnars appearing as a single one, and that following might have been in a similar condition. Even if this were not so, the stem structure of *B. equatorialis* throws a new light on the specific variation in *Bathycrinus*, and suggests strongly that the stem of *B. aldrichianus* as figured is in all essentials correct. At the time the species was dredged by the "Challenger," the only small stalked crinoids on board were five specimens of *Rhizocrinus*; as all of the five had the characteristic basals still attached to the stems, confusion with them is out of the question. In the same haul with *B. aldrichianus*, it is recorded that *Hyoocrinus* stems were secured; but the stem as figured is certainly not that of a *Hyoocrinus*. Sixteen days later *Rhizocrinus* was dredged again; but in this case also the basals were *in situ*. Four months later *Bathycrinus australis* and *Hyoocrinus* were dredged; but the stem cannot be that of either of these. It was not until the last of February three years later that any more small stalked crinoids were found, too late for their stems to have become incorporated in the figure.

Type Cat. 22,664, U. S. National Museum, from "Albatross" Station No. 4742, 0° 3.4' north latitude, 117° 15.8' west longitude, 2320 fathoms, taken February 15, 1905.

Bathycrinus caribbeus, sp. nov

Radials and arms lacking.

Basals closely united into a smooth ring, slightly wider above than below, longer than wide, the sides perfectly straight.

Stem 85 mm. long with about one hundred segments, the proximal seven short and discoidal, then rapidly becoming longer, reaching a length of 1.3 mm. with a width of 0.4 mm. in the middle of the stem, the last segment being 2.8 mm. long by 1.2 mm. in diameter at its much expanded end. Above the middle of the stem the columnars are cylindrical; distally the articulations become more and more prominent and are greatly expanded on the last two segments.

While it is possible that the elongated basals and small number of short discoidal joints in this specimen are indications of immaturity, the completely anchylosed condition of the basals and the apparently full complement of columnars seem to show that this is not the case; and that the latter may be characteristic of much larger specimens we have just seen in the case of *B. equatorialis*.

Bathycrinus caribbeus forms an interesting addition to the crinoid fauna of the Caribbean Sea, the more so since the depth at which it was found is considerably less than the lowest previous record for the genus (*B. carpenterii* 743 fathoms), while the bottom temperature (40° F.) is remarkably high.

Type Cat. 22,665, U. S. National Museum, from "Albatross" station No. 2751, 16° 54' 00" north latitude, 63° 12' 00" west longitude, 687 fathoms; blue Globigerina ooze; bottom temperature, 40° F.

The discovery of four species of *Bathycrinus* since the publication of the

"Challenger" report makes a key to the species of the genus very desirable, especially since Dr. Carpenter in his key only included the three species discovered by the "Challenger" and the "Porcupine," omitting the interesting form dredged by the "Vøringen." In the preparation of the following key I have examined specimens of all the species given, with the exception of *B. aldrichianus*. There are two additional species as yet undescribed, one dredged by the "Valdivia" off Enderby Land, and the other from the Atlantic coast of the United States.

Key to the species of *Bathycrinus*.

A. Basal ring squarish, or wider than high.

a. basal ring with straight or concave sides; columnars markedly "dice-box shaped," the articulations prominent; 10-25 short discoidal columnars at summit of stem.

b. arms perfectly smooth, brachials not overlapping.

c. costals and brachials low and rounded, non-carinate.

d. first brachials as long as or longer than wide; columnars short, 25 or more at summit of stem wider than high. (Northern and northeastern Atlantic).

B. carpenterii (Danielssen and Koren).

dd. first brachials wider than long; columnars long, 15 or less at summit of stem wider than high. (Northwestern Pacific). *B. complanatus* A. H. Clark.

cc. costals distinctly carinate; brachials high, compressed, and carinate. (Near the Crozet Islands). *B. australis* A. H. Clark.

bb. brachials with raised and prominent distal edges, imparting a serrate appearance to the arms.

c. costals with a strong, rounded, median keel.

d. lower part of radial funnel much constricted. (Equatorial Atlantic). *B. aldrichianus* Wyville Thomson.

dd. radial funnel slopes evenly downward from the upper to the lower edge. (Coasts of southern Europe).

B. gracilis Wyville Thomson.

cc. costals with no trace of a median keel. (Off southern Japan).

B. pacificus A. H. Clark.

aa. basal ring with markedly convex sides; columnars cylindrical; five short discoidal columnars at summit of stem. (Equatorial Pacific).

B. equatorialis, sp. nov.

AA. Basal ring markedly longer than wide. (Caribbean Sea). *B. caribbeus*, sp. nov.

The following table gives the bathymetrical, thermal, and geographical range of each species of *Bathycrinus*, and of the genus as a whole, as now known; but the data given will doubtless be greatly modified by future discoveries, as but one species, *B. carpenterii*, can be considered to be even approximately understood; it is probable that the geographical range, even of this species, is much greater than that given, and there may be a corresponding lack of information in regard to the limits of the thermal and bathymetrical altitudes inhabited by it.

	Minimum Depth (Fathoms).	Maximum Depth (Fathoms).	Mean.*	Minimum Temperature (Fahrenheit).	Maximum Temperature (Fahrenheit).	Mean.*	Geographical Distribution.
<i>Bathyrinus</i>	687	2535	1581	30.9°	40.0°	36.3°	Probably cosmopolitan, but bounded by narrow thermal and bathymetrical limits.
<i>B. carpenteri</i>	743	1539	1116	30.9	34.8	32.8	Between Scandinavia and Iceland and northward.
<i>B. gracilis</i>	1093	2435	1764	36.5	36.5	36.5	Eastern Atlantic, from Finisterre south to about the Canary Islands (47° 38' N. to about 30° N.).
<i>B. aldrichianus</i>	1850	1850	1850	36.6	36.6	36.6	Mid-Atlantic, east of St. Paul's Rocks (1° 47' N. 24° 26' W.).
<i>B. caribbeus</i>	687	687	687	40.0	40.0	40.0	Caribbean Sea.
<i>B. australis</i>	1375	1600	1487	34.2	36.6	35.4	Near the Crozet Islands, SW. of the Indian Ocean.
<i>B. complanatus</i>	1567	1567	1567	—	—	—	About 40 miles SSW. $\frac{1}{3}$ W. of Copper Island, Commander group.
<i>B. pacificus</i>	905	905	905	36.6°	36.6°	36.6°	Off southern Japan.
<i>B. equatorialis</i>	2320	2320	2320	—	—	—	Between the Marquesas Islands and Central America (0° 3.4' N. 117° 15.8' W.).
<i>B. sp.</i>	2535	2535	2535	—	—	—	Off Enderby Land (about 66° S. 50° E.).

* Computed from all the published records.

UNSTALKED CRINOIDS.

Heliometra rhomboidea (P. H. CARPENTER.)

This species was met with during the "Albatross" Eastern Pacific Expedition at three stations near the Central American coast; in all, four specimens were secured, a calyx without arms or cirri (Station No. 4622), an immature specimen and fragments of the arms of an adult (Station No. 4621), and a nearly perfect specimen, but with only three cirri remaining (Station No. 4630).

The specimen from Station No. 4630 expands 300 mm. The three remaining cirri have fifty-four, fifty-two, and forty-eight segments respectively. The first pinnule is 18 mm. long, with fifty-five segments, the second 22 mm. long, with fifty-three, and the third 17 mm. long, with thirty-one. The second pinnule is rather stouter than the first, the segments proportionately slightly longer; the third pinnule has the segments considerably elongated; the two following pinnules are about the length of the third, but have twenty-five to thirty segments, of which the terminal five or six are short, the others elongated. In the ten arms syzygia occur in all cases in the third brachials, nine times in the eighth (once in the ninth), once in the twelfth, twice in the thirteenth, five times in the fourteenth, and once in the fifteenth (the tenth arm is missing). Distally syzygia occur forty times at intervals of three brachials, eight times at intervals of four, and six times at intervals of two.

It will be seen that this specimen is almost identical with the one described by Dr. Hartlaub from the bay of Panama. I quite agree with him that it must be referred to *H. rhomboidea*, in spite of the fact that the species is not known between Panama and the Straits of Magellan. It is quite distinct from any of the numerous forms found along the shores of the north Pacific which were unknown at the time Dr. Hartlaub wrote.

The detached arms from Station No. 4621 are somewhat different from those of the specimen just noticed. The brachials are quadrate, all longer than wide, becoming elongate distally and overlapping, the distal border finely serrate; a close comparison shows that the brachials overlap rather more than do those of the other specimen, and the arms are therefore more rough, while the two proximal pinnule segments are proportionately somewhat larger (the first shorter and more oblong) and more expanded laterally, the second being more distinctly trapezoidal. The distal intersyzygial interval is decidedly more variable, being in four cases of two brachials, eight cases of three, thirteen of four, seven of five, six of six, four of seven, one of eight, and one of nine. These differences, however, are of minor systematic importance in this species, and, in fact, in many species of *Heliometra*, although in others they may be of considerable value, and I have no hesitation in assigning this specimen, as well as the previous one, to *H. rhomboidea*. Station No. 4621 also yielded a small specimen having an expanse of 150 mm. The cirri have thirty-six segments, the third syzygy is usually in the fourteenth brachial (but once in the fifteenth), and the distal intersyzygial interval is three to five (usually three) segments. It will be seen that this

specimen, in regard to the disposition of the syzygia, most nearly agrees with the first.

The example from Station No. 4622 consisted merely of a calyx, without cirri, and with the arms lost after the third or eighth brachials; as nearly as can be determined, however, it is identical with the preceding.

In the more perfect specimen, the cirri had from forty-eight to fifty-four segments, while *H. rhomboidea* is given as having forty or less. This, however, is a matter of no importance, for the three remaining cirri of the specimen are of the type frequently seen on the extreme upper edge of the centro-dorsal in many species of *Heliopecten* (in the type *H. eschrichtii*, for example) which are somewhat abnormal in being longer than usual, slender, with more than the normal number of segments; these must not be confused with the "long-mature" cirri of *Dr. Carpenter*, which arise just below them.

The following localities are added to the known distribution of *Heliopecten rhomboidea*:

Station No. 4621. 6° 36' north latitude, 81° 44' west longitude, 36.4 miles from land; 581 fathoms.

Station No. 4622. 6° 31' north latitude, 81° 44' west longitude, 40.8 miles from land; 581 fathoms.

Station No. 4630. 6° 53' north latitude, 81° 42' 5" west longitude, 556 fathoms; green sand, large Globigerinae; bottom temperature, 40.5° F.

Heliopecten juvenalis, sp. nov.

Centro-dorsal hemispherical, bearing twenty to thirty cirri; these are 10-12 mm. long with fifteen to twenty segments, mostly somewhat longer than wide, but becoming squarish distally; there are no dorsal spines, but the distal border of the last five to ten segments is somewhat raised; basals plainly visible as interradial tubercles; radials about twice as wide as long; first costals rather shorter than the radials; axillaries pentagonal, about as long as wide; the costals are rounded and well separated laterally; ten arms 75 mm. long, the first brachial short and wedge shaped, the second larger and irregular, the four following oblong; from this point the brachials become obliquely quadrate, longer than wide, becoming more elongate distally; first pinnule 2 mm. long, with four or five squarish segments; second pinnule similar, but slightly longer; third pinnule longer still, with eight segments; the fourth pinnule is 4 mm. long, with about twelve segments; but the fifth is 6 mm. long, with fifteen segments, mostly rather longer than broad, of which the third, fourth, and fifth bear a large rounded genital gland; the fourteen following pinnules are similar, and bear also large genital glands, after which the pinnules become more slender, and do not develop genital glands; syzygia occur in the third, eighth, and twelfth brachials, and distally at intervals of three.

Color (in spirits) dull yellow; probably bright yellow in life.

Types Cat. 283, 284 M. C. Z., from off Cape Raper, Davis Strait; 60 fathoms; taken September 13, 1892, by Rev. A. M. Norman.

The two specimens upon which this species is based are among the most extraordinary unstalked crinoids I have ever seen; that they are adult is shown by the great enlargement of the genital glands, which contain ova; but all the other characters, the prominent basals, long radials, costals, and brachials, and rudimentary lower pinnules, and the few cirrus joints, are clearly juvenile, and in general the specimens appear to be much less developed than some of the very large *H. hondoensis*, which are less than half their size.

Psathyrometra, sp.

Some fragments of arms from "Albatross" Station No. 2818, 0° 29' 00" south latitude, 89° 54' 30" west longitude (Galapagos Islands), belong to a species of this genus, possibly *P. bigradata*, which has been found in the Galapagos group. The specimen was taken in 392 fathoms on a bottom of black and white sand, the bottom temperature being 43.9° F. The Galapagos specimen of *P. bigradata* was found in 385 fathoms, at a temperature of 43.2° F.

This is the first record for the arms of any species of the genus, outside of the Bering Sea and Sea of Japan, where fairly good specimens have been obtained. Dr. Hartlaub's examples all lacked the arms beyond the syzygy in the third brachial, and this is the condition in which species of this genus are usually recovered, as is the case with the closely allied *Zenometra* of the Caribbean Sea.

Antedon serrata, sp. nov.

Centro-dorsal low-hemispherical, bearing about thirty cirri; these are 7 mm. or 8 mm. long, and consist of eleven to fourteen segments, the first two short, the others rather longer than wide; the proximal half are more or less "dice-box" shaped; opposing spine minute; radials just visible as small interradiial triangles; first costals very short; axillaries triangular, about twice as wide as high; ten arms 45 mm. long; first two brachials wedge shaped, the longer side out; third brachial wedge shaped, the longer side in; next three brachials oblong, then becoming quadrate, at first short, but after the eleventh about as long as wide, and elongate after the middle of the arm; syzygia occur in the third, eighth, and twelfth brachials, and distally at intervals of two; first pinnule 5 mm. long, composed of fifteen segments, the first very short, the second rather longer than broad, then becoming elongated; the ends of the segments are turned outward and produced dorsally, and armed with very fine spines; the five following pinnules are similar to the first, but considerably shorter, with the distal eversion of the pinnule segments more marked, the dorsal projection equal to from one half to nearly the whole length of the segment; the remaining pinnules become more slender, and the projection of the distal end of the pinnule segments gradually dies away.

Color (in spirits) brownish, the arms narrowly banded on about every third brachial with darker.

Type Cat. 254 M. C. Z., from Tokio Bay, Japan, 8-12 fathoms, Alan Owston collection, taken October 22, 1899.

The great amount of eversion and overlapping of the lower pinnule segments make this species one of the most readily distinguishable of the genus.

Antedon psyche, sp. nov.

Centro-dorsal low-hemispherical, bearing thirty to thirty-five cirri, the pole bare; cirri 7 mm. long, with fifteen or sixteen segments, all slightly longer than wide, remarkably uniform, the articulations somewhat expanded; there are no dorsal spines, but the opposing spine is prominent; radials visible as a low triangle in the interradiar area; first costals low and wide, deeply incised by the axillary, and with a prominent latero-anterior tubercle; axillaries broader than long, produced posteriorly, where they rise into a slight rounded tubercle; the first costals and axillaries are in apposition laterally, but are not laterally flattened. Ten arms 55 mm. long, the first brachial wedge shaped (the shorter side in), the second irregular, and the third squarish; two following brachials roughly oblong, then quadrate, becoming triangular, longer than wide after the ninth, quadrate again at about the middle of the arm, and much elongate and "dice-box" shaped distally. First pinnule, 4 mm. long, with eight to ten segments, the first squarish, the following becoming progressively elongated; the pinnule tapers gradually from the base to the tip; second pinnule 7 mm. long, at the base about as stout as the first, but flagellate distally; it contains eleven segments, the first shorter than broad, the second longer than broad, the others elongated; the distal segments have the distal edges set with fine spines; the third pinnule resembles the second, but is shorter, and the fourth is shorter still, about the length of the first; the following pinnules become more slender, the distal pinnules being 7 mm. long, very slender, with fifteen to eighteen segments, the first two somewhat enlarged, the first broader than long, the second trapezoidal, and the others greatly elongated and slender.

Syzygia occur in the third, eighth, and twelfth brachials, and distally at intervals of one brachial.

Color (in spirits) light pinkish, the lower part of the arms, the calyx, and cirri, white.

Type Cat. 252 M. C. Z., Japan, probably in the vicinity of Tokio or Sagami bays. Alan Owston collection.

This species belongs to a small but interesting group of the genus *Antedon*, the species of which are characterized by small size, small number of cirrus segments, and by having the first pinnule never longer, and usually shorter and somewhat stiffer, than those following; the group comprises such species as *Antedon nana*, *A. briseis*, *A. minuta*, and *A. adrestine*, and occurs from Amboina and the Tonga islands northward to Japan. The comparatively large number of cirri on a hemispherical centro-dorsal, and the length of the second pinnule (which is much the longest) suffice to distinguish *A. psyche* from the other described species of this group.

Himerometra acuta, sp. nov.

Centro-dorsal discoidal or low-hemispherical, bearing about thirty-five marginal cirri; these are 20 mm. long with twenty segments, about half of which are rather longer than wide, the remainder squarish; the terminal segments are rather compressed laterally, and have a faint dorsal keel passing into the spine of the penultimate; radials just visible in the angles of the calyx; first costals short, oblong, free laterally, furnished with a rounded lateral projection; axillaries low pentagonal, nearly twice as broad as long; distichals two, articulated; the junctions of the costals, distichals, and lower brachials more or less tubercular, the costals and distichals having rounded lateral projections; twenty arms 85 mm. to 90 mm. long, the first six brachials oblong, the following obliquely quadrate (almost triangular), about half as long as wide, becoming less obliquely quadrate and finally oblong distally; first pinnule 4.5 mm. long, slender, weak, and tapering, with twelve or thirteen segments, the first three short, the remainder becoming progressively longer; second pinnule 10 mm. long, much stouter than the first, stiff and styliform, with fifteen segments, the first two wider than long, the remainder elongated; following pinnules shorter than the first, with about eight segments, gradually increasing in length distally.

Color (in formalin) yellow-brown, the skeleton dull yellow.

Types Cat. 288 M. C. Z. from Fiji, collected November 25, 1897; four specimens.

This species comes nearest to *Himerometra marginata* (P. H. Carpenter) from the Philippines, but the great enlargement of the second pinnule, which is styliform, stiff, and rigid, serves to distinguish it at a glance.

Himerometra heliaster, sp. nov.

Centro-dorsal low-hemispherical or thick discoidal, bearing thirty to thirty-five cirri in two or three more or less irregular marginal rows; cirri 20 mm. to 23 mm. long, with seventeen to twenty-three segments, mostly rather longer than broad, the distal without dorsal spines; opposing spine well developed; terminal claw short and curved; radials concealed; first costals narrow, oblong, about four times as wide as long; costal axillaries pentagonal, somewhat broader than long; costals rounded and widely free laterally, their junction slightly tubercular; distichals and palmars 2, the axillary resembling the costal axillary, the preceding segment like the first costal, but somewhat longer; twenty-five to thirty arms 125 mm. long, the first five or six brachials oblong and slightly tubercular, then becoming quadrate, nearly triangular at the seventh or eighth (much wider than long), then becoming gradually less and less obliquely quadrate, and practically oblong at the tips of the arms; syzygia occur in the third brachials, again between the sixteenth and twentieth, and distally at intervals of one to eleven (usually five or six); first pinnule 9 mm. long, slender and flagellate, with twenty-five segments, the first three squarish, then gradually becoming elongated (about twice as

long as wide, or even a little more, in the outer third of the pinnule), then short again on the terminal segments; second pinnule 15 mm. long, much stouter than the first, stiff, composed of fifteen segments, the first three squarish, then rapidly becoming elongated, reaching a maximum length (on the eleventh or twelfth) of somewhat over three times the width; third and following pinnules much shorter than the first (5 mm.), with twelve to fifteen segments, becoming gradually longer and more slender distally, where they are 9 mm. long. The first distichals, first palmars, and first brachials are united basally, but free distally; the axillaries and second and following brachials are widely free. In one arm of the type both the first and second brachials contain syzygies, and both bear pinnules.

Color (in spirits) grayish brown.

Type Cat. 290 M. C. Z. from Ebon, Marshall Islands, collected by Rev. B. G. Snow.

Himerometra persica sp. nov.

Centro-dorsal low-hemispherical, bearing about twenty-five cirri, a large area at the pole free; cirri 27 mm. long with thirty-five segments, mostly slightly longer than wide, becoming squarish distally, the last sixteen to eighteen bearing sharp dorsal spines; radials just visible; first costals trapezoidal, about three times as broad as long, axillaries pentagonal, about once and a half as broad as long, with a sharp anterior angle; costals rounded and widely free; distichals 4 (3+4) or 2; twenty to twenty-five arms 150 mm. long, the first eight brachials roughly oblong, then quadrate (much broader than long), becoming oblong toward the ends of the arms; a syzygy in the third brachial, another at about the seventeenth, and others distally at intervals of five to twelve (usually about seven); distichal pinnule 13 mm. long with thirty-six segments, all somewhat longer than wide, but not much so; the pinnule is very slender and flagellate, the first four segments being the broadest, and being slightly carinate; first brachial pinnule similar, but longer (16 mm.) and stouter basally, the five or six proximal segments sharply carinate, the pinnule then tapering gradually to the long delicate flagellate tip; the next pinnule is the same as that on the second brachial, and of the same length; the next few pinnules decrease rapidly in length, then increase somewhat distally, but do not become very long; the carination of the basal pinnule segments becomes less and less marked, and is not noticeable after the sixth; it is at its maximum on the pinnules of the second and fourth brachials.

Color (in spirits) dull brown, the skeleton somewhat lighter.

Types Cat. 291 M. C. Z. from the Persian Gulf, collected by F. W. Townsend.

This species is not very nearly related to any of the other species of *Himerometra*; according to the key given by Hartlaub for the "Savignyi Group" it would fall with *H. crassipinna*; but the slender and flagellate lower pinnules serve at once to distinguish it.

Note on six-rayed specimens of *Tropiometra carinata* (LAM.).

Six-rayed individuals of recent free crinoids have hitherto been regarded as quite rare. Although tetraradiate examples are not uncommon, I can find but a single record of a specimen with more than five radials. It was therefore with considerable surprise that I found among about three hundred and forty specimens of *Tropiometra carinata* no less than seventeen. It is interesting that all of the six-rayed specimens came from Rio Janeiro, all of the sixty or more from Zanzibar and Mauritius being normal. This gives us for the Brazilian specimens 6 % of six-rayed individuals.

These six-rayed specimens are all but one of comparatively small size, the diameter being between 100 mm. and 120 mm., the exception having an expanse of 190 mm.; this last is the only one sexually mature. Normal specimens of this species average from 230 mm. to 270 mm. in diameter, the size of those from Rio, Zanzibar, and the south Pacific being practically the same.

An examination of the disks of twelve of the specimens shows that in three cases it is quite impossible to determine which is the extra ray, as there are six ambulacra converging on the disk, all precisely alike; an examination of the rays themselves also furnishes no clue; one specimen has the interpolated ray between the two on the left side, one has it behind the right posterior, while seven have the extra ray inserted behind the left posterior.

Dr. Carpenter, in his monograph on the "Comatulæ" collected by the "Challenger," mentions a small dry six-rayed "Antedon" in the British Museum collection. Suspecting from my examination of these specimens that it was probably an example of the same species, and also from Brazil, I wrote to Professor Bell of the British Museum for information concerning it. He very kindly replied that it was, as I had surmised, *Tropiometra carinata*, but there was no record of the locality whence it had come.

In the recent stalked crinoids it is interesting to note that *Rhizocrinus lofotensis* alone is known with more than five rays, and, as in *Tropiometra carinata*, this variation is confined to a single locality, the coast of Norway.

Among the fossil crinoids six-rayed individuals appear to be extremely rare, the figure by Rosinus (De stellis marinis quondam nunc fossilibus, p. 24, no. 3, pl. 1, fig. 3, 1719) of a six-rayed *Encrinus liliiformis* being the only record I know of this condition.

The genera used for the free crinoids in this paper are those recently proposed in a preliminary paper on a revision of the family Antedonidae (*sensu* A. H. Clark, 1907), in which that family is restricted so as to be equivalent to the genus Antedon, as understood by Dr. P. H. Carpenter. The old genus Antedon is broken up into a number of well-marked homogeneous genera, whereby the inter-relations of the various species are much better shown than by the old method of uniting some three hundred or more widely varying specific types under one generic name. The following key shows the relations of these genera to each other from the point of view of differential characters. There are, in addition

to those given, two other types which should be raised to generic rank, but, as they are both West Indian and do not occur in the territory where the free crinoids considered here are found, it has seemed desirable to leave them for a report upon West Indian species.

Key to the genera of Antedonidae.

A. Pinnule ambulacra plated.

a. pinnules stout and prismatic, stiff, and closely set; radials and costals, and lower brachials, strongly flattened laterally (*i. e.* "wall-sided").

b. first pinnule similar to, but shorter than, those following; cirri very long, with more than 80 segments; the distal pinnules extend for several millimeters beyond the terminal brachials, which are abruptly recurved.

c. centro-dorsal long-conical or columnar, the cirri in 5 double vertical rows; cirri stout; 10-20 arms

Asterometra (*Antedon macropoda* A. H. CLARK).

cc. centro-dorsal thick-discoidal or columnar, the cirri without definite arrangement, or in 15 more or less defined vertical rows; cirri slender; 10-30 arms

Ptilometra (*Comatula macronema* J. MÜLLER).

bb. first pinnule longer than those following; the distal pinnules short, not extending beyond the terminal brachials, which are not incurved.

c. first pinnule markedly larger, stouter, and longer than those following, composed of comparatively few large, stout segments; cirri elongate, slender, always spiny, with more than 25 segments; genital pinnules not differentiated; 10-30 arms

Thalassometra (*Antedon villosa* A. H. CLARK).

cc. first pinnule longer, but smaller and more slender than those following, with much more numerous and shorter joints; cirri short, stout, and smooth, with less than 30 segments; genital pinnules always more or less expanded; 10-50 arms

Charitometra (*Antedon incisa* P. H. CARPENTER).

aa. pinnules rounded-carinate, the genital pinnules much expanded; costals and lower brachials laterally compressed, with concave sides, the former with broad, thin, flange-like latero-posterior borders; cirri short, stout, and smooth; 10 arms

Poecilometra (*Antedon acoela* P. H. CARPENTER).

aaa. pinnules cylindrical, stiff and spine-like, well separated, the first small, short, and weak, with squarish joints; proximal segment of lower pinnules (especially the first) enormously expanded; cirri spiny; 10-50 arms

Calometra (*Antedon callista* A. H. CLARK).

aaaa. proximal pinnules slender, elongate, cylindrical, stiff, with much elongated segments, the first shorter than the following; distal pinnules strongly prismatic; costals and lower brachials rounded, free laterally; 20-30 arms

Stylometra (*Antedon spinifera* P. H. CARPENTER).

AA. Pinnule ambulacra not plated.

a. a pinnule on the third (epizygal) brachial.

b. costals united by syzygy; disk always more or less plated . . .

Zygometra (*Antedon microdiscus* BELL).

bb. costals united by bifascial articulation; disk naked, or with small, scattered, calcareous granules.

c. lower pinnules stout and prismatic, subequal in length; costals and lower brachials in close apposition, with sharply flattened sides.

d. one of the lower pinnules somewhat enlarged; first two brachials not enlarged; first pinnule as large as or larger than the second or third; distal pinnules do not extend beyond tip of arm; brachials long, triangular, or quadrate; 10 arms

Nanometra (*Antedon minor* A. H. CLARK).

dd. lower pinnules about equal in size, but the first somewhat shorter than those following; distal pinnules extend beyond tip of arm; brachials very short, oblong, or short-quadrate, the first two disproportionately large; 10 arms

Tropiometra (*Comatula carinata* LAMARCK).

cc. one or more of the lower pinnules elongated, slender, and flagellate, cylindrical, or flattened.

d. the greatly elongated and flagellate lower pinnules are composed of very numerous short and broad segments, and are more or less serrate toward the tip; costals always well-separated and rounded; centro-dorsal hemispherical, with very numerous cirri, which are long with numerous segments, long proximally, shorter distally, where they are sharply carinate or bear low spines; terminal claw curved, moderate in length, or short, always with an opposing spine; middle and distal brachials triangular or quadrate; 10 arms

Helio-metra (*Alecto eschrichtii* J. MÜLLER).

dd. the first of the greatly elongated and flagellate lower pinnules is composed of very numerous short and broad segments; but the others are composed of greatly elongated smooth segments; rays rounded, well-separated; centro-dorsal discoidal, bearing very numerous cirri, which are long, with greatly elongated smooth segments; terminal claw long and nearly straight, with no opposing spine; middle and distal brachials oblong; 10 arms

Thysanometra (*Antedon tenelloides* A. H. CLARK).

ddd. all of the lower pinnules have elongated segments.

e. first segment of the elongated lower pinnules always short; costals and lower brachials usually rounded and free laterally, occasionally

flattened against each other; centro-dorsal hemispherical or discoidal, the cirri without definite arrangement; cirrus segments fairly uniform throughout, one or more always markedly "dice-box shaped;" 10 arms

Antedon de Fréminville, 1811, (*Asterias bifida* PENNANT).

ee. all the pinnules, especially the lower, greatly elongated, the latter composed of greatly elongated segments of which the first, like those following, is greatly elongated; centro-dorsal conical or columnar, with 5 broad inter-radial areas or ridges dividing it into five radial areas, each with definite vertical rows of cirrus sockets; 10 arms.

f. costals and lower brachials smooth, well separated, and rounded, cirri smooth, with all the segments elongated, arranged in 3, 4, or 5 vertical rows in each radial area.

Psathyrometra (*Antedon fragilis* A. H. CLARK).

ff. costals and lower brachials in close apposition and strongly "wall-sided"; cirri with much elongated segments proximally, very short and spiny segments distally, arranged in two vertical rows in each radial area

Zenometra (*Antedon columnaris* P. H. CARPENTER).

ccc. lower pinnules cylindrical, one or more very stout, styliform, and more or less elongated.

d. cirri with 50-70 short segments, bearing stout spines distally; first pinnule only enlarged, greatly elongated; following pinnules very short, in abrupt contrast; costals and lower brachials with straight sides, the former rounded and widely separated; brachials triangular or quadrate, rather long; 40-60 arms

Pontiometra (*Antedon andersoni* P. H. CARPENTER).

dd. cirri with 15-40 subequal short segments; the enlarged lower pinnules followed by pinnules of intermediate character.

e. cirri irregularly placed on a discoidal centro-dorsal; costals and lower brachials with convex sides, giving them a characteristic swollen appearance; brachials short, mostly oblong or short-quadrate; 10-50 arms

Himerometra (*Antedon crassipinna* HARTLAUB).

ee. cirri in ten vertical rows on a conical centro-dorsal; costals and lower brachials with straight sides; brachials long; 10-15 arms.

Adelometra (*Antedon angustiradia* P. H. CARPENTER).

aa. no pinnule on the third (epizygal) brachial.

- b.* centro-dorsal discoidal, the few short and stout cirri in two or three irregular marginal rows; radials and lower brachials not tubercular; 10-30 arms

Cyllometra (*Antedon manca* P. H. CARPENTER).

- bb.* centro-dorsal conical, the numerous elongate and slender cirri in more or less definite vertical rows; costals and lower brachials strongly tubercular; 10 arms

Perometra (*Antedon diomedae* A. H. CLARK).